

# ANNALS of CARNEGIE MUSEUM

4400 FORBES AVENUE • PITTSBURGH, PENNSYLVANIA 15213

VOLUME 44

DECEMBER 31, 1973

ARTICLE 10

## FOUR NEW PIRASOCRINID CRINOIDS FROM THE AMES LIMESTONE, PENNSYLVANIAN, OF BROOKE COUNTY, WEST VIRGINIA

J. J. BURKE<sup>1</sup>

### INTRODUCTION

A Carnegie Museum collection of Pennsylvanian crinoids from the Ames Limestone, Conemaugh Group, of Brooke County, West Virginia, is of particular interest, as it includes several species that appear to be confined to the Upper Pennsylvanian of the Appalachian region, and for the most part to the Ames Limestone. The Ames is generally regarded as of Upper Missourian age, but documentation of Upper Missourian crinoids is still far from complete. Future exploration may determine the presence of these species in the Pennsylvanian of other regions, in which case they should prove of value for stratigraphic correlation.

While the present paper deals with four new pirasocrinids from the Ames Limestone of Brooke County, West Virginia, treatment of some of the West Virginia forms is supplemented by description of specimens from the Ames of Carroll County, Ohio, which are now deposited in the National Museum of Natural History. Ohio specimens were collected by Ohio University field parties under the supervision of Dr. Myron T. Sturgeon, through whose kindness I was originally afforded an opportunity to study the material.

I wish to express my thanks to the authorities of Ohio University, the National Museum of Natural History (NMNH), and Carnegie Museum (CM) for the privilege of investigating and describing these specimens. I also greatly appreciate the assistance of the West Virginia Geological Survey, which generously supported this project.

<sup>1</sup>Research Associate, West Virginia Geological Survey; Curator of Collections, Cleveland Museum of Natural History, Wade Oval, University Circle, Cleveland, Ohio 44106.

Submitted for publication June 22, 1972.

I am grateful to Dr. Robert V. Kesling and Mr. Karoly Kutasi of the Museum of Paleontology, University of Michigan, for the photographs from which the illustrations were made.

#### SYSTEMATICS

Family Pirasocrinidae Moore and Laudon, 1943

Genus *Plaxocrinus* Moore and Plummer, 1938

***Plaxocrinus buffaloensis*?, new species**

Figures 1-5

**DIAGNOSIS:** A fair-sized species; diameter of dorsal cup of holotype 24.1 mm. H/W=0.23. Basal impression moderate; posterior interradius broadly impressed. Interradial notches present. Basals curve downward abruptly from contact with infrabasals; basals and radials slightly convex. Radials not reaching the basal plane and forefacets steeply sloping but not strongly arcuate. Primibrachs with lateral slopes noticeably divergent from spines. Tegmen-roof spines long, slender, and spade-shaped proximally.

**TYPES:** Holotype CM 33785, a dorsal cup with five primibrachs and portion of one arm retaining five secundibrachs; associated plates include one complete tegmen-roof spine. Paratype NMNH 170558, a dorsal cup with two primibrachs and one secundibrach in association.

**OCCURRENCE:** Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

**LOCALITIES:** Holotype CM 33785 from an excavation (Tunnel Road Cut) for West Virginia Route 67 (lat 40°14'24" N, long 80°35'53" W) near McKinleyville, Brooke County, West Virginia. Paratype NMNH 170558 from Joe Skinner Quarry, NW¼NE¼ sec. 13 (lat 40°34'20" N, long 81°01'20" W), Center Township, about 3 miles east of Carrollton, Carroll County, Ohio.

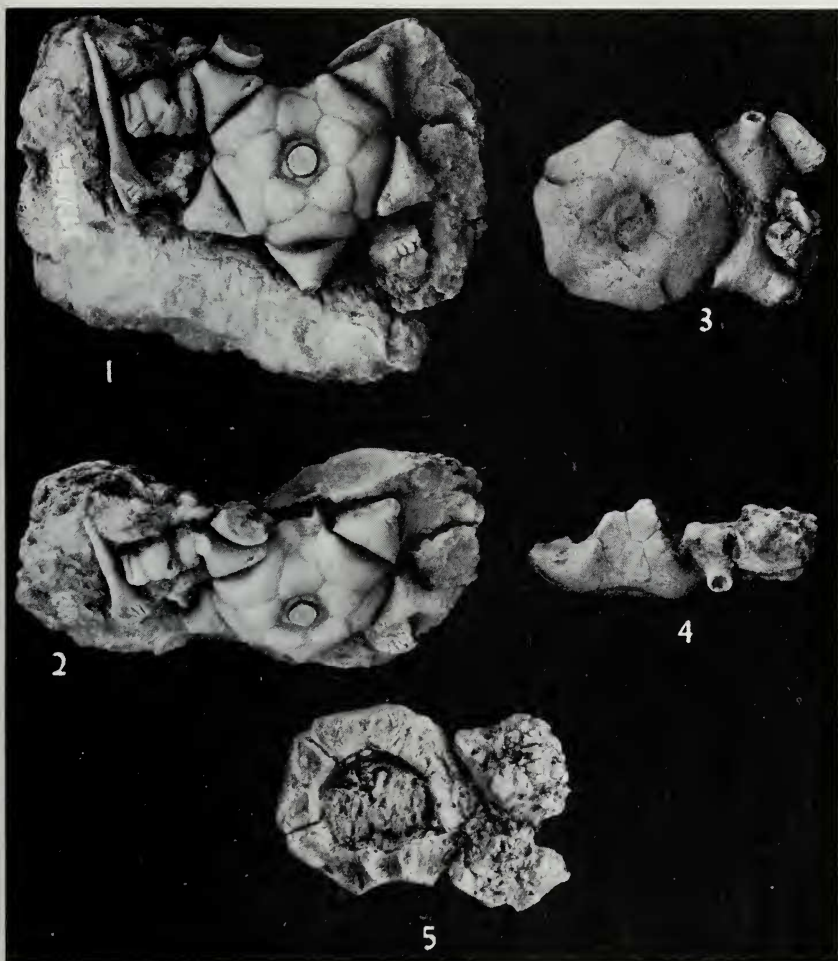
**DESCRIPTION:** Dorsal cup low, truncate bowl-shaped. Posterior interradius indented; outline of cup irregularly pentagonal in dorsal and ventral view. Cup diameter more than four times the height. Height of basal impression more than one-fourth height of cup; width of impression less than half the diameter of cup. Stem round, culmina about 34, lumen pentalobate. Infrabasals extend well beyond stem impression, curve rather abruptly downward from impression, then more gently upward to meet basals. Basals curve steeply downward proximally, otherwise both basals and radials somewhat convex, especially so in the older specimen, NMNH 170558 (paratype). Plates of both circlets most convex longitudinally. Basals visible in lateral view. Sutures between basals and radials in low hollows in holotype, CM 33785; hollows not evident in paratype NMNH 170558.

Outward and upward slopes of radials terminate in fairly steep, inward-sloping but not strongly arcuate forefacets. Interradial sutures in low hollows; interradian notches present; most prominent in paratype NMNH 170558.

Outward slope of radial articular surface moderate. Outer marginal ridge curved and visible in lateral view, together with outer ligament ridge and relatively short, slit-like outer ligament pit. Interradial notches limit outer facet area and transverse ridge falls short of full width of plate; ridge denticulate, narrows in vicinity of outer ligament pit, then expands rather abruptly, but narrows to extremities. Intermuscular notch broad and angular. Intermuscular furrow, in form of broad V, divides muscle areas. Impressed area between triangular intermuscular elevation and transverse ridge.

Radianal intervenes between C radial and CD basal; does not contact BC basal. In holotype, anal X rests on truncate CD basal, separating D radial and radianal. In paratype, anal X also intervenes between D radial and radianal, but barely contacts CD basal where four plates have common juncture at lower lateral angle of D radial. In both

<sup>2</sup>Named for Buffalo Creek, which skirts the locality where the holotype was found.



Figs. 1-5. *Plaxocrinus buffaloensis*, new species. Figs. 1-2, holotype, CM 33785. Fig. 1: dorsal view. Fig. 2: oblique dorsal view showing posterior interradius. Figs. 3-4: paratype, NMNH 170558. Fig. 3: dorsal view. Fig. 4: posterior view. Fig. 5: ventral view. All X 1.

specimens, anal X bears articular faces for  $IBr_1$ , tube plate on left, and another tube plate above. In paratype, rt contacts radianal, anal X, and D radial, also bears facets for articulation with  $IBr_1$  on right, together with facets on the left and above for articulation with other tube plates. In the holotype, rt damaged on left; articulation in other areas essentially as in paratype.

$IBr_1$  axillary and spiniferous; lateral slopes noticeably divergent from spines. Length  $IBr_1$  (C ray of holotype) 4.6 mm, width 9.7 mm; all five spines of  $IBr_1$  of holotype and spines of two  $IBr_1$  associated with paratype broken and in various stages of regeneration. Spine of C-ray  $IBr_1$  of holotype also damaged by boring organism. C- and B-ray  $IBr_1$  of holotype removed for study. Proximal articular facets of  $IBr_1$  much like articular facets

of radials, but two channels extend from intermuscular notch to distal surface of each plate. Channels flank sides of strong ridge that divides distal surface into right and left facets, which articulate with  $II\text{Br}_1$ . Each channel leads into depression on inner side of denticulate transverse ridge, which intervenes between depression and outer ligament pit. Outer marginal ridges and ligament ridges similar to those of radials, as are articular surfaces adjacent to body chamber, but surfaces on side toward spine reduced and troughlike.

$II\text{Br}_1$  of right arm of D ray displaced; removed for study. Length 3.1 mm, width 7.3 mm. Proximal surface resembles  $I\text{Br}_1$  surface with which it articulates. Flangelike extension articulates with side of ridge dividing axillary facets of  $I\text{Br}_1$ . Channel leads through fork of intermuscular notch to reach distal surface. Distal surface bears external ligament pit with denticulations external to it and very faint transverse ridge. Short intermuscular furrow reaches to broad intermuscular notch and joins channel, which extends upward from proximal surface. Smooth areas on each side of intermuscular notch give way to broad rugose areas extending to lateral margins.

Left arm of D ray of holotype retains  $II\text{Br}_{1-5}$ .  $II\text{Br}_1$  uniserial, quadrangular and appears normal in all respects.  $II\text{Br}_{2,3}$  cucinate, greatly swollen, apparently represent myzostome galls, having typical myzostome perforation along their common suture.  $II\text{Br}_4$  quadrangular, does not extend full width of arm, appears swollen apparently in response to myzostome attack also.  $II\text{Br}_5$  extremely slender, rises higher on the right than on left and does not extend full width of arm—essentially a broadly cucinate plate.

Four tegmen-roof plates associated with holotype; one small, hexagonal; three others large, spiniferous. One spiniferous plate complete; spine long (length appr. 24.5 mm) slender, spade-shaped in proximal region, flattened dorsally, bent downward ventrally, showing characteristic coarse canal-like structures.

Holotype retains granulose ornament, mainly on infrabasals and proximal parts of basals, but also along borders of basal and radial sutures and on portions of primibrachs.

TABLE 1. LINEAR MEASUREMENTS OF TYPES, *Plaxocrinus buffaloensis* (IN MM)

	Holotype CM 33785	Paratype NMNH 170558
Height of dorsal cup	5.5	6.1
Width of dorsal cup	24.1	26.6*
Ratio of height to width	0.23	0.23
Height of basal impression	—	1.7*
Width of basal impression	10.2	11.3*
Width of stem impression	4.3	—
Width of infrabasal circlet	6.0	6.4*
Length of basal	5.5(AB)	6.4(AB)
Width of basal	6.4(AB)	7.0(AB)
Length of radial	6.8(B)	7.3(A)
Width of radial	12.0(B)	14.6(A)
Length of suture between basals	2.0	3.1
Length of suture between radials	3.8	5.5
Length of radianal	4.3	6.1
Width of radianal	2.8	4.5
Length of anal X	5.2	7.1
Width of anal X	4.0	4.5
Length of right tube plate	4.9*	5.8
Width of right tube plate	3.2	5.0

\*Approximate

REMARKS: In size and proportions in general, this species seems to bear closest resemblance to *Plaxocrinus normalis* Strimple (1961). From the latter it appears to differ mainly in having a slightly higher dorsal cup, more convex basals, radials that fail to reach the basal plane, sides of primibrachs more divergent from spines, and more delicate tegmen-plate spines that are less expanded from side to side proximally.

The presumed myzostome infestation of an arm of the holotype is similar to those noted in *Schedexocrinus gibberellus* and *Plaxocrinus normalis* by Strimple (1961). The regenerating primibrach spines are also evidence of injury during life. The breakage of these spines is so uniform as to suggest that they might have been nipped off by some small fish, like *Peripristis semicircularis*, which is associated with these crinoids in the Ames Limestone. The boring on one of the spines, however, might have been a post-mortem occurrence.

### **Plaxocrinus conemaughensis<sup>3</sup> new species**

Figures 6-12

DIAGNOSIS: Dorsal cup size about medium for *Plaxocrinus* (known width range 18.0 to 20.8 mm). Cup about four times as wide as high. Posterior interradius impressed. Basal impression relatively shallow; proximal curvature of basals gentle. Basals slightly, radials moderately convex. D radial extends to basal plane. Interradial notches present. First primibrachs spiniferous and axillary. First and second secundibrachs quadrangular, third and fourth cuneate, fifth axillary. Tegmen roof umbrella type. Ornament granulate, confined to infrabasals and proximal portions of basals.

TYPES: Holotype CM 33787, a complete dorsal cup. Paratype CM 33788, dorsal cup with E radial damaged. Paratype CM 33789, basal portion of dorsal cup. Paratype NMNH 170557, part of crown with dorsal cup, portions of arms and parts of tegmen-roof plates.

OCCURRENCE: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

LOCALITIES: Holotype CM 33787 and paratypes CM 33788 and 33789 from an excavation (Tunnel Road Cut) for West Virginia Route 67 (lat 40°14'24" N, long 80°35'53" W) near McKinleyville, Brooke County, West Virginia. Paratype NMNH 170557 from Joe Skinner Quarry, NW¼NE¼ sec. 13 (lat 40°34'20" N, long 81°01'20" W), Center Township, about 3 miles east of Carrollton, Carroll County, Ohio.

DESCRIPTION: Dorsal cup low, truncate bowl-shaped, irregularly pentagonal in dorsal or ventral view because of impressed posterior interradius. Cup about four times as wide as high. Height of basal impression about one-half height of cup; width of impression more than one-half diameter of cup in holotype, CM 33787, slightly less than two-fifths that of diameter in large paratype, CM 33788. Stem impression round, showing about 30 culmina in mature specimens, lumen pentalobate. Infrabasal plates curve downward slightly from stem impression, then slightly upward to meet basals. Basals gently convex, most convex longitudinally, visible in lateral view, curve abruptly downward and outward from junction with infrabasals, then upward and outward along cup wall beyond basal plane. Sutures between basals and radials in shallow furrows.

Radials slightly convex, most convex longitudinally. D radial reaches basal plane. (In holotype, B radial, slightly displaced, also reaches basal plane.) Interradial furrows

<sup>3</sup>Named for the Conemaugh Group, Pennsylvanian.



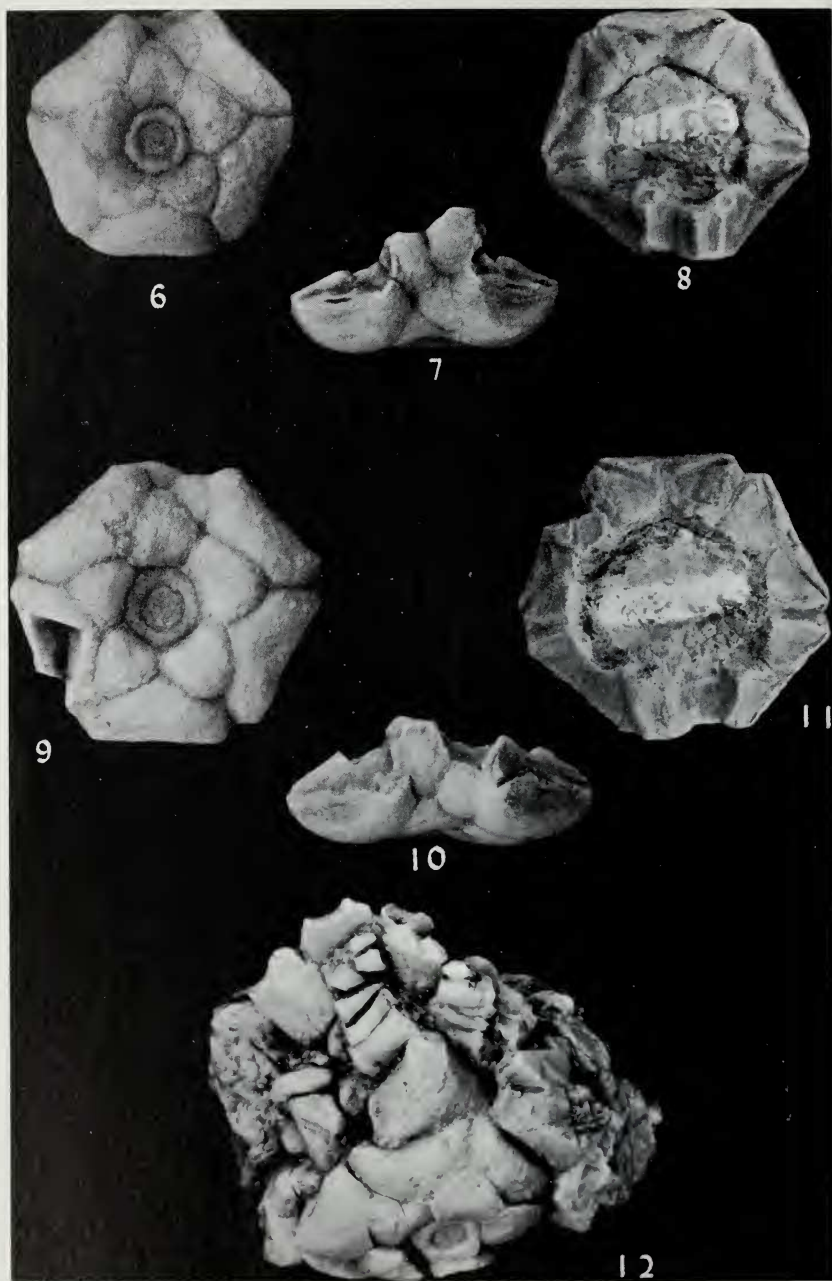


TABLE 2. LINEAR MEASUREMENTS, DORSAL CUPS, *Plaxocrinus conemaughensis* (IN MM)

	Holotype CM 33787	Paratype CM 33788	Paratype NMNH 170557
Height of dorsal cup	4.6	5.4	—
Width of dorsal cup	18.0	20.8	—
Ratio of height to width	0.26	0.26	—
Height of basal impression	2.0	2.8	—
Width of basal impression	9.6	8.6*	—
Width of stem impression	2.8	3.0	2.6
Width of infrabasal circlet	4.3	5.2	4.7
Length of AB basal	4.0	4.5	4.5
Width of AB basal	4.8	5.1	5.0
Length of A radial	5.3	5.3	5.0*
Width of A radial	9.5	10.6	9.0
Length of suture between basals	1.6	1.5	2.2
Length of suture between radials	3.9	3.9	3.8
Length of radianal	4.5	4.6	4.2
Width of radianal	2.7	2.5	1.9*
Length of anal X	4.3	5.0	—
Width of anal X	2.8	4.0	2.9**
Length of right tube plate	4.5	—	—
Width of right tube plate	3.5	—	—

\*Approximate

\*\*Estimated

shallow, but deeper than furrows between basals and radials. Holotype shows inter-radial notches, notches more conspicuous in large paratype, CM 33788. Forefacet steep, not strongly arcuate, shows some concavity. Radial articular facets face outward. Outer marginal ridge distinct, visible in lateral view, together with external ligament ridge and pit. Ligament pit moderately elongate, not slitlike. Transverse ridge strong, denticulate; narrows in area between external ligament pit and intermuscular depression. Lateral furrows shallow, paralleling transverse ridge. Adsutural slopes moderate. Intermuscular notches broad, more V-shaped in posterior radials. Intermuscular furrows shallow prolongations of notches. Muscle areas broad, lobelike. Plates of posterior interradius normal in paratypes NMNH 170557 and CM 33788, but radianal barely touches BC basal in CM 33788 and in holotype CM 33787. Radianal of holotype meets D radial on left, preventing anal X from contacting CD basal.

Plates of dorsal cup of NMNH 170557 dislocated, but specimen preserves portions of five primibrachs, parts of two arms, and some plates of tegmen roof. All IBr<sub>1</sub> damaged; spines apparently of medium length. A-ray IBr<sub>1</sub> length 4.7 mm, width 9 mm (est.); plate bears two arms each with four IIBr<sub>1</sub>; IIBr<sub>4</sub> axillary. IIBr<sub>1</sub> and IIBr<sub>2</sub> uniserial and quadrangular, but IIBr<sub>2</sub> very narrow, its width much greater than length. IIBr<sub>1</sub> cuneate and attenuated, in right ray does not extend full width of arm. IIBr<sub>4</sub> length 1.8 mm, width 3.9 mm; longest side above tip of IIBr<sub>3</sub> wedge. Five or six proximal portions of tegmen-roof spines in place; spines widely spade shaped proximally, flat above, a little convex from side to side below.

Figs. 6-12. *Plaxocrinus conemaughensis*, new species. Figs. 6-8, holotype, CM 33787. Fig. 6: dorsal view. Fig. 7: posterior view. Fig. 8: ventral view. Figs. 9-11: paratype, CM 33788. Fig. 9: dorsal view. Fig. 10: posterior view. Fig. 11: ventral view. Fig. 12, paratype, NMNH 170557: A-ray view of damaged crown. All X 2.

Ornament finely granulose, confined to infrabasals and proximal regions of basals. Mostly eliminated in preparation of holotype CM 33787 and paratype CM 33788, but well preserved in paratypes NMNH 170557 and CM 33789.

REMARKS: Unfortunately, species of *Plaxocrinus* that compare best with the form under description are known only from dorsal cups. In this respect, *Plaxocrinus conemaughensis* resembles both *Plaxocrinus crassidiscus* Miller and Gurley, 1894, and *Plaxocrinus parilis* Moore and Plummer, 1940. The dorsal cup is sharply distinguished from those of both of the latter species, however, by the slight convexity of its basal plates. It also differs in having the D radial reaching the basal plane. The type specimens of *Plaxocrinus conemaughensis* also exceed known individuals of *Plaxocrinus crassidiscus* and *Plaxocrinus parilis* in size. In general, though, *Plaxocrinus conemaughensis* bears closest resemblance to *Plaxocrinus crassidiscus*, the dorsal cup approaching that of the latter species in (1) the slight depth of its basal impression, (2) lack of angulation between its infrabasal and basal circlets, which characterizes *Plaxocrinus parilis*, (3) showing definite impression of the posterior interradius, and (4) having ornament of identical type and distribution. However, the Conemaugh species differs from *Plaxocrinus crassidiscus* and resembles *Plaxocrinus parilis* in having a relatively lower dorsal cup with less convex radials.

### ***Plaxocrinus amesi*<sup>4</sup> new species**

#### **Figures 13-15**

DIAGNOSIS: A small species: width of dorsal cup (holotype) 13.1 mm. Basal impression moderate. Posterior interradius only faintly impressed. Infrabasals slightly convex; extend well beyond stem impression. Basals mildly convex, relatively large, curve down abruptly from junction with infrabasals. CD and EA basals fail to reach basal plane. Radials more convex than in *Plaxocrinus crassidiscus*, with much less dorsal exposure



Figs. 13-15. *Plaxocrinus amesi*, new species. Holotype, CM 5037. Fig. 13: dorsal view. Fig. 14: posterior view. Fig. 15: ventral view. All X 2.

<sup>4</sup>Named for the Ames Limestone.



and more arcuate forefacets. Cup plates lack ornament.

TYPE: Holotype CM 5037, a well preserved dorsal cup.

REFERRED SPECIMEN: CM 5039, damaged dorsal cup of young specimen.

OCCURRENCE: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

LOCALITY: Painters Run (Painter Hollow), lat 40°15'45" N, long 80°35'33" W, near Wellsburg, Brooke County, West Virginia.

DESCRIPTION: Dorsal cup of holotype small, truncate bowl-shaped, irregularly rounded in dorsal view, pentagonal in ventral view. Posterior interradius only faintly impressed. Cup about three times wider than high. Basal impression less than one-third height of cup, width of impression about half the width of cup. Stem impression pentagonal, more than half the width of infrabasal circlet, shows about 23 culmina, and slopes downward from pentalobate lumen. Infrabasals very gently convex, slope downward from stem impression, then upward slightly to meet basals. Basals convex, more so longitudinally than transversely, visible in lateral view, curve downward rather abruptly from contact with infrabasals, less steeply outward and upward along cup wall, tend to bend inward at distal tips. CD and EA basals fail to reach basal plane. Interbasal sutures, and sutures between radials and basals, in shallow furrows.

Radials convex in areas bordering cup-plate sutures, least convex transversely. Forefacets prominent, arcuate; extend to about midheight of plates, slope inward steeply to summit of cup. Low furrows mark interrarial sutures. Interradial notches barely indicated. Radial articular facets face outward slightly. External marginal ridge bowed, barely distinguishable from external ligament ridge. External ligament pit and both external ridges visible in lateral view of cup; ligament pit slightly elongate, not slitlike. Transverse ridge strong, denticulate; narrows in vicinity of external ligament pit, borders intermuscular depression on inner side. Lateral furrows shallow, run parallel to transverse ridge. Adsutural slopes prominent, not steep. Intermuscular notches wide V-shaped; grade into intermuscular furrows with little distinction; muscle areas triangular.

Plates of posterior interradius (radial, anal X, and rt) in normal arrangement. Distal extremity of rt extends well beyond distal termination of anal X.

Reference of CM 5039 to species tentative; specimen young, damaged; dorsal cup height 4.8 mm, width 10 mm, height of basal impression 1.6 mm, but cup plates resemble those of holotype; CD and EA basals do not reach basal plane.

TABLE 3. LINEAR MEASUREMENTS OF HOLOTYPE, *Plaxocrinus amesi*, CM 5037 (IN MM)

Height of dorsal cup	4.2
Width of dorsal cup	13.1
Ratio of height to width	0.32
Height of basal impression	1.3
Width of basal impression	6.4
Width of stem impression	2.2
Width of infrabasal circlet	3.8
Length of AB basal	3.5
Width of AB basal	4.0
Length of A radial	4.0
Width of A radial	7.4
Length of suture between basals	1.6
Length of suture between radials	2.2
Length of radial	3.6
Width of radial	2.8
Length of anal X	3.2
Width of anal X	2.3
Length of right tube plate	3.0
Width of right tube plate	2.1

REMARKS: This is a smaller species than *Plaxocrinus crassidiscus*. The dorsal cup is relatively higher, the cup plates lack ornament, the stem impression is smaller, the infrabasals are convex rather than flattened, and the basals are relatively larger. In addition, the radials are more reduced and more convex, with more arcuate forefacets that extend to about midheight.

In a previous study (Burke, 1930, unpublished) I identified the holotype of this species and the referred specimen as *Hydreionocrinus discus* Meek and Worthen. The type of *Hydreionocrinus discus* is missing, possibly lost, and I have not been able to make direct comparison of these Ames Limestone specimens with it. In cup height, shape, and proportions of the radials, slight impression of the posterior interradius, and virtual absence of interrarial notches, *Plaxocrinus amesi* approaches the Meek and Worthen species. However, those authors note (1860, 1866) that in *Hydreionocrinus discus*, the base (infrabasal circlet) is flat and the subradials (basals) extend "nearly horizontally outward from the base." In these respects, *Hydreionocrinus discus* contrasts sharply with *Plaxocrinus amesi*. These peculiarities of *H. discus* in the basal region of the cup strongly suggest the genus *Anchicrinus* Strimple and Watkins, 1969, however, and I am now convinced that *Hydreionocrinus discus* will eventually prove to be an *Anchicrinus*.

### Genus *Anchicrinus* Strimple and Watkins, 1969

#### *Anchicrinus roberti*<sup>5</sup> new species

#### Figures 16-21

DIAGNOSIS: A species resembling *Anchicrinus virginarius* (Moore), new combination, but differing in having a smaller dorsal cup that bears distinctive ornament, has small pits at corners of cup plates, shows no distal impression of the posterior interradius at the summit and lacks interrarial notches.

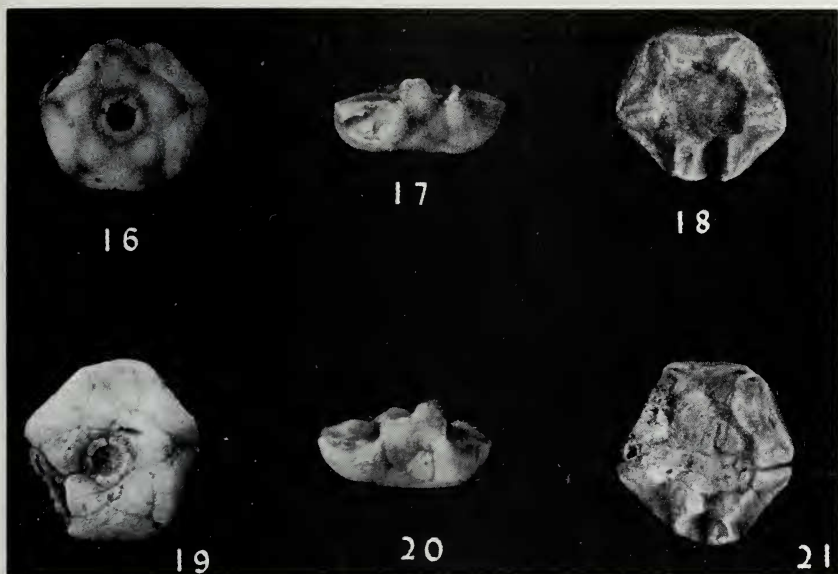
TYPES: Holotype CM 33786, a dorsal cup with damaged D radial and right tube plate lost. Paratype CM 5038, a worn dorsal cup lacking the E radial.

OCCURRENCE: Ames Limestone, Conemaugh Group, Upper Pennsylvanian.

LOCALITIES: Holotype CM 33786 from Tunnel Road Cut, an excavation for West Virginia Route 67 (lat 40°14'24" N, long 80°35'53" W) near McKinleyville, Brooke County, West Virginia. Paratype CM 5038 from Painters Run (Painter Hollow), (lat 40°15'45" N., long 80°35'33" W), near Wellsburg, Brooke County, West Virginia.

DESCRIPTION OF HOLOTYPE: Dorsal cup small, truncate bowl-shaped, pentagonal in ventral view, rounded pentagonal in dorsal view, somewhat more than three times as wide as high. Basal impression extremely shallow, less than 1 mm in height, slightly less than half the cup diameter in width. Posterior interradius slightly impressed proximally. Infrabasals essentially flat; width of infrabasal circlet nearly twice that of pentagonal stem impression. Basals with slight curvature downward from juncture with infrabasals; plates only slightly convex, visible in lateral view, with sharpest curvature beyond basal plane; all basals tending to be slightly impressed at distal extremities. CD basal elongate, least convex, does not reach basal plane.

<sup>5</sup>Named for my brother, Robert, in appreciation of his help in collecting crinoids from the Ames Limestone.



Figs. 16-21. *Anchicrinus roberti*, new species. Figs. 16-18, holotype, CM 33786. Fig. 16: dorsal view. Fig. 17: posterior view. Fig. 18: ventral view. Figs. 19-21, paratype, CM 5038. Fig. 19: dorsal view. Fig. 20: posterior view. Fig. 21: ventral view. All X 2.

Beyond proximal tips of radials, sutures between basals and radials in shallow furrows. Radials strongly convex proximally and along sides, most convex transversely, proximal tips in basal impression, corners of plates indented at junctions with distal tips of basals. Hollows bound interrarial sutures proximally; hollows absent distally. Interrarial notches also absent. Prominent, steep, lunate forefacet extends downward from superior corners of radial to well below midheight of plate, sloping upward and inward to radial summit. Forefacet abruptly terminates outward slope of radial, contributing to pentagonal outline of cup in dorsal view. Radial facets face outward moderately; details poorly preserved. Outer marginal ridge, outer ligament ridge and outer ligament pit face outward; ridges curved, ligament pit elongate but not slitlike. Transverse ridge strong, but finer features obliterated. Lateral furrows obscure, but indicated. Adsutural slopes prominent; muscle areas face outward. Intermuscular notches V-shaped in posterior radials, broader in other radials.

Anal X and radianal still in place; rt missing. Anal X rests on truncated tip of CD basal below; on left abuts against D radial and bears facet for  $1Br_1$ , shows facet above for articulation with tube plate, on right carries facet for rt and rests against radianal. Radianal in normal contact with BC radial below and with C radial on right, but greatly attenuated distally; barely meets with rt.

Pits or dimples at corners of anal plates similar to those marking tips of basals at junctions with interrarial sutures. All plates of cup ornamented with fine, glistening angular granulations.

COMPARISON WITH PARATYPE: Paratype CM 5038, a larger (and older) individual than holotype specimen, CM 33786; E radial missing and cup plates worn, but right tube plate (absent in holotype) preserved. Characteristic ornament still remains on some infrabasals and plates of posterior interradius; some pits at corners of plates also pre-

served. Actual height of cup less than that of holotype, and cup nearly four times wider than high.

Basal impression shallow, as in holotype, but all cup plates less tumid; hollows along sutures between radials and basals almost obliterated. Radials with gentler slopes and greater exposure in dorsal view; forefacets steep, but much less extensive and less arcuate.

Radial facets facing outward much more steeply than in holotype. Transverse ridges better preserved; ridge shows denticulations and narrows to form border or prominent intermuscular depressions. Lateral furrows shallow, broad; extend parallel to transverse ridge.

Plates of posterior interradius show normal arrangement; rt makes broad contact with radianal.

Measurements of types are summarized below.

TABLE 4. LINEAR MEASUREMENTS, *Anchicrinus roberti* (IN MM)

	Holotype CM 33786	Paratype CM 5038
Height of dorsal cup	3.6	3.0
Width of dorsal cup	11.3	11.7
Ratio of height to width	0.33	0.26
Height of basal impression	0.8	1.0
Width of basal impression	5.0	5.8
Width of stem impression	1.8	2.2
Width of infrabasal circlet	3.2	3.2
Length of AB basal	2.7	2.8
Width of AB basal	3.1	3.3
Length of A radial	3.5	3.5
Width of A radial	5.9	6.2
Length of suture between basals	0.9	1.1
Length of suture between radials	2.4	2.3
Length of radianal	3.8	3.2
Width of radianal	1.4	2.0
Length of anal X	3.0	3.1
Width of anal X	2.4	2.6
Length of right tube plate	—	3.4
Width of right tube plate	—	2.5

REMARKS: This little species is quite evidently congeneric with *Anchicrinus toddi* Strimple and Watkins (1969), showing a shallow basal concavity, gently convex basals, and a tendency for the proximal tips of the radials to extend into the basal impression—all characteristic of *Anchicrinus*. However, except as noted in the diagnosis, the dorsal cup of *Anchicrinus roberti* also resembles that of a specimen described by Moore (1939) as *Plaxocrinus virginarius*. The latter is evidently another representative of the Strimple and Watkins genus, for which I propose the designation *Anchicrinus virginarius* (Moore), new combination.

Previously (Burke, MS, 1930) I identified the paratype of *Anchicrinus roberti*, CM 5038, as *Hydreionocrinus discus* Meek and Worthen,

1860. The Meek and Worthen species may also prove to be an *Anchicrinus*, as I have indicated above in connection with *Plaxocrinus amesi*, but *H. discus* differs from *Anchicrinus roberti* not only in being an unornamented form, but also in showing differences in arrangement and proportions of the anal plates that are probably significant at the species level.

#### REFERENCES CITED

MEEK, F. B., AND A. H. WORTHEN

1860. Descriptions of new species of Crinoidea and Echinoidea from the Carboniferous rocks of Illinois and other western states: Proc. Nat. Acad. Sci. Philadelphia 4:379-397.

1866. Description of invertebrates from the Carboniferous system: Illinois Geol. Surv. 2:143-411, pl. 14-32.

MILLER, S. S. AND W. F. E. GURLEY

1894. Descriptions of some new species of invertebrates from the Paleozoic rocks of Illinois and adjacent states: Illinois State Mus. Nat. Hist. Bull. 3:1-81, pl. 1-8.

MOORE, R. C.

1939. New crinoids from Upper Pennsylvanian and Lower Permian rocks of Oklahoma, Kansas and Nebraska: Denison Univ. Bull. 39 Jour. Sci. Lab. 34:171-279, pl. 5-9.

MOORE, R. C. AND F. B. PLUMMER

1940. Crinoids from the Upper Carboniferous and Permian strata in Texas: Texas Univ. Bull. 3945:1-468, pl. 1-21.

STRIMPLE, H. L.

1961. Late Desmoinesian crinoid faunule from Oklahoma: Oklahoma Geol. Bull. 93:1-189, pl. 1-19.

STRIMPLE, H. L. AND W. T. WATKINS

1969. Carboniferous crinoids of Texas with stratigraphic implications: Paleont. Americana 6(40):1-275, pl. 1-56.